for a controversial consideration of the questions at issue.

This resurrection of obsolete tracts and essays is part of the anti-vivisectionist's stock-in-trade. It enables him to repeat in a book published in 1908 the details of experiments made more than half a century ago, and to quote the utterances of a Mantegazza or a Magendie in a volume dealing with the work of physiologists and bacteriologists to-day. If speaking as avowed vivisectionists we characterised such experiments of Mantegazza, we should admit without hesitation that they were cruel. We have advanced in humanity since those days. Even in England, Boyle and his fellow members of the Royal Society approached the subject of experiments on animals—by asphyxiation—without any suspicion that they were employing cruelty in their methods.

But what have these instances to do with the question of experiments on animals as practised in English physiological laboratories to-day? A remark by Dr. Leffingwell himself may be commended to the attention of the secretary of the anti-vivisectionist society which publishes his collection of essays. In the first essay, Dr. Leffingwell says:—

> "In America our physiologists are rather followers of Magendie and Bernard, after the methods in vogue at Paris and Leipzig, than men who are governed by the cautious and sensitive conservatism which generally characterises the physiological teaching of London and Oxford."

That was written by Dr. Leffingwell in 1880.

If the practice of English physiological laboratories was cautious and sensitive twenty-nine years ago, what is the object of re-publishing in England as a contribution to the "Vivisection Controversy" a series of attacks on vivisection as practised in other countries a generation, or more than a generation, ago? What, also, is the object of adding an essay on the "Royal Commission of 1906"—except to give to the book an appearance of being up to date? The only serious argument in the essay is that "A. C. E." mixture—which is commonly employed on human beings as a very good anæsthetic—ought not to be employed in experiments on animals. This essay is in keeping with the rest of the book in being an appeal, not to facts, but to prejudice, and not to humanity, but to ignorance. E. S. G.

STRENGTH OF STRUCTURES AND MATERIALS.

(1) *The Theory and Design of Structures.* By Ewart S. Andrews. Pp. xii+589. (London: Chapman and Hall, Ltd., 1908.) Price 9*s.* net.

(2) *The Strength of Materials.* By Prof. Arthur Morley. Pp. ix+487. (London: Longmans, Green and Co., 1908.) Price 7*s.* 6*d.* net.

(1) THE soundness of this work as regards the theory of the subject is guaranteed by the fact that the methods adopted by the author in dealing with the more difficult problems are based upon lecture notes taken while he was attending the graphics lectures of Prof. Karl Pearson, F.R.S., at University College, London. In the first chapter, which is devoted to the general treatment of the subject of strain, stress, and elasticity, the author deals not only with the case of maximum tensile or compressive and sheer stresses, but also with maximum strain. It is too often forgotten in dealing with complex stresses that the maximum strain does not occur on the same plane as the maximum stress; it is, therefore, advisable to investigate the question of the maximum stress produced in a body when subjected to combined tensile or compressive and shear stress from this point of view. This method of maximum strain, which the author terms the French method, is comparatively little used by engineers in this country, but it is important that designers and students should realise that there is another method of treating the problem other than that ordinarily expounded in English text-books.

In the section of the book which treats of areas and moments, ingenious graphical methods are described for the determination of areas by means of sum or integral curves, and for the determination of centroids and moments of inertia by similar methods. It is perhaps desirable to point out here that throughout this book there is a large number of examples fully worked out by both graphical and analytical methods, and in many cases points which are not, or only briefly, touched upon in the general body of the book are fully discussed when solving some of the problems. These worked problems, therefore, will be found of much greater use to the student than is often the case with the examples published in engineering text-books.

Mr. Andrews, in conjunction with Prof. Karl Pearson, was the author of an original memoir on the theory of stresses in cranes and coupling hooks, and it was only to be expected that the cases where the ordinary assumptions of the beam theory are not allowable would be discussed in this book; it is to be hoped, therefore, that in future, erroneous theories of the stresses in crane and coupling hooks will disappear from engineering text-books. The correct method of solving the problem certainly involves rather more lengthy calculations, but there is no justification for the sacrifice of accuracy in the calculation of stresses in order to simplify slightly the work of the designer, especially when the results given by the simple formula are seriously incorrect.

Three chapters are devoted to the deflection of beams, simple, fixed, and continuous, and the distribution of shearing stresses in them; the author has adopted the ordinary analytical method of dealing with the problems, and also a graphical method based upon Mohr's theorem that a loaded beam will take up the same shape as an imaginary cable of the same span which is loaded with the bending moment curve on the beam, and subjected to a horizontal pull equal to the flexural rigidity. In spite of increased attention given to mathematical studies, many engineers are still unable, though they have a slight knowledge of the principles of the calculus, to reason in its terms, and such men need graphical methods in order that they shall secure a thorough grip of the problem of beam deflections and stresses.

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In discussing the strength of struts, the author points out that the chief difficulty in dealing with struts lies in the choice of the safe stresses per square inch for various values of the buckling factor, and the effects of eccentric loading of stanchions illustrate how desirable it is to have the load as central as possible. In the chapter devoted to masonry structures, there is a good deal of matter not usually found in text-books, and a brief reference is given to the recent developments of the theory of stresses in masonry dams, due to the original researches of Prof. Karl Pearson; and, in deducing formulæ for the strength of retaining walls, three theories are explained—the Rankine, the wedge, and the Scheffler.

In dealing with the subject of reinforced concrete, the author points out that a great deal of experimental work is still required in this direction before the principles underlying design shall be established on a sure and certain foundation, and he points out the danger of the uninitiated using data obtained from investigations on materials quite different from those which he proposes to use in his own design. The last three chapters are devoted to designs of steel work for various buildings, roofs and bridges, and a number of excellent practical details are given, and illustrations of recent structural steel work.

This book undoubtedly marks a considerable improvement in the type of text-book which has recently been placed at the disposal of engineering students in connection with the theory and design of structures. There are original methods of dealing with problems, the theory is in all cases unimpeachable, and the numerous examples selected for illustrating these various theories have been chosen with admirable judgment. The book, however, is more than a mere text-book for students; it will be found of considerable use by draughtsmen and engineers who are engaged in constructional steel and iron work.

(2) Though this book has been written mainly for engineering students, and from the point of view of university examinations, it will undoubtedly prove most useful to practical engineers. So many text-books have now been written on this subject that it becomes extremely difficult for an author to embody anything strikingly original. Prof. Morley has, however, devoted considerable attention to several branches of the subject which are ordinarily passed over, or only briefly touched upon in most of the works dealing with the subject of strength of materials.

In chapter ii. there is a *résumé* of the theories which are held as to whether or not, in cases other than simple direct stresses, the breaking down of a bar in a machine or structure occurs for a certain value of the maximum principal stress, for a certain value of the maximum principal strain, or for a certain value of the maximum shearing stress. Throughout the book the first of these theories is generally employed, but its use has to be justified by the choice of a factor of safety which is reckoned on the ultimate and not on the elastic strength of the material, and which must be varied according to circumstances.

In chapter xii., the problems involved in the strength of rotating discs and cylinders are fully investigated, and also the bending of originally curved bars, such as crane hooks, for example. The strength of flat plates is treated in chapter xiii. in a very complete manner by means of the Bernouilli-Euler theory of bending, with such modifications as are required to allow for flexure in other than a single plane. Another useful chapter is that devoted to the subject of vibrations and critical speeds, in which is incorporated the results of Prof. Dunkerley's researches on the whirling speed of rotating shafts. In chapter xvi., Prof. Morley has given descriptions of a number of the special testing machines which have been introduced in recent years for impact and hardness tests, and copious references have been given to the memoirs which have been published dealing with researches and investigations undertaken with the aid of these special machines.

Every chapter contains a number of fully-worked-out examples, and there is a good selection of examples for practice by the student, and, in the form of an appendix, are given tables of logarithms, such as would be required in the working out of these examples.

The book is a valuable addition to the library of the engineer who has to undertake the calculation of the stresses and strains in machinery and structures.

WIRELESS TELEGRAPHY.

An Elementary Manual of Radio-telegraphy and Radio-telephony for Students and Operators. By Dr. J. A. Fleming, F.R.S. Pp. xiv+340. (London: Longmans, Green, and Co., 1908.) Price 7*s.* 6*d.* net.

La Télégraphie sans Fil et les Applications pratiques des Ondes électriques. By Albert Turpain. Second edition. Pp. xi+396. (Paris: Gauthier-Villars, 1908.) Price 9 francs.

Jahrbuch der drahtlosen Telegraphie und Telephonie. Vol i., part iv. Edited by Dr. Gustav Eichorn. (Leipzig: Verlag von S. Hirzel, 1908.)

WE have already had occasion to review in these columns Dr. Fleming's treatise on "The Principles of Electric Wave Telegraphy," and at the time we expressed the opinion that that treatise not only admirably filled a gap in the literature of the subject, but deserved to rank as the most important, if not the only, book on wireless telegraphy which students need consult. It must be frankly admitted, however, that by writing the present manual Dr. Fleming has performed another service to this branch of electrotechnology, in the exposition of which he stands, certainly in this country and probably in any country, easily first. The former treatise was possibly too exhaustive and in parts too difficult for those who had not the ability or inclination to study the subject thoroughly. It must be remembered that wireless telegraphy has become in recent years a department of applied electricity of great practical importance, offering a steadily increasing field of employment for large numbers of men. The majority

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